United States Department of Agriculture

Oak Wilt Disease Management

Environmental Assessment

Forest Service
Chequamegon-Nicolet National Forest

July 2021

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ENVIRONMENTAL ASSESSMENT

PROJECT INFORMATION

Project Name: Oak Wilt Disease Management

Project Initiation Date: 3/24/2020

Interdisciplinary Team Leader: N. Ginger Molitor

Districts: Eagle River-Florence, Lakewood-Laona, Medford-Park Falls, Great Divide, and Washburn
County(ies): Ashland, Bayfield, Florence, Forest, Langlade, Oconto, Oneida, Price, Sawyer, Taylor, Vilas

Anticipated Implementation: September 2021

Line Officer/Signing Authority: Paul Strong, Forest Supervisor

PALS Tracking #: 57903

Project File: https://usfs.app.box.com/folder/60140148513
GIS Info: T:\FS\NFS\ChequamegonNicolet\Project\SO\EAForestwideOakWilt\GIS
Project Webpage: https://www.fs.usda.gov/project/?project=57903

General Location: Chequamegon-Nicolet National Forest – 1.5 million acres

Watersheds: 5th level Hydrologic Unit Codes (HUCs)

West Fork Chippewa River
Brule River
Pine River
Lower North Branch Oconto River
Otter Creek and Rat River
Upper South Fork Flambeau River
Upper Yellow River
Deerskin River
South Branch Oconto River
Eagle River
Marengo River
Popple River
White River
Upper Bad River
East Fork Chippewa River
Elk River
Upper Peshtigo River
Fish Creek
Upper Peshtigo River
Fish Creek
Upper Namekagon River
Bayfield Peninsula Northwest
Middle Peshtigo and Thunder Rivers
Iron River
Bayfield Peninsula Southeast
Trappers and Pine Creeks
Tamarack Pioneer River
Middle Tomahawk River
Lake Chippewa
Lower North Fork Flambeau River
Upper South Fork Jump River
Middle Jump River
Lily River
Upper Wolf River and Post Lake
Wolf River/Langlade and Evergreen Rivers
Totagatic River
Weirgor Creek and Brunet River
Thornapple River
Somo River
Upper Saint Croix and Eau Claire Rivers
Pike River
Flambeau Flowage
Pelican River

PURPOSE & NEED AND PROPOSED ACTION

Oak wilt, caused by the fungus *Bretziella fagacearum*, is the most serious disease of oaks in the Lake States. Oaks in the red oak group are most susceptible. The fungus kills the infected tree within just a few weeks by blocking the flow of water and nutrients throughout the tree. The following spring, spore mats and pressure pads form beneath the bark of the recently killed tree. These structures expand and force the bark to split. Sap-feeding nitidulid beetles are attracted to these fruity-smelling spore mats, where they pick up spores. Overland spread of oak wilt occurs when spore-covered nitidulid beetles are attracted to a fresh wound on an oak tree in a previously disease-free stand as shown in figure 1 (O'Brien et al. 2011). Once the disease is established in a stand, the fungus can spread from an infected tree to nearby healthy trees through root grafts, creating an expanding pocket of dead oak trees.

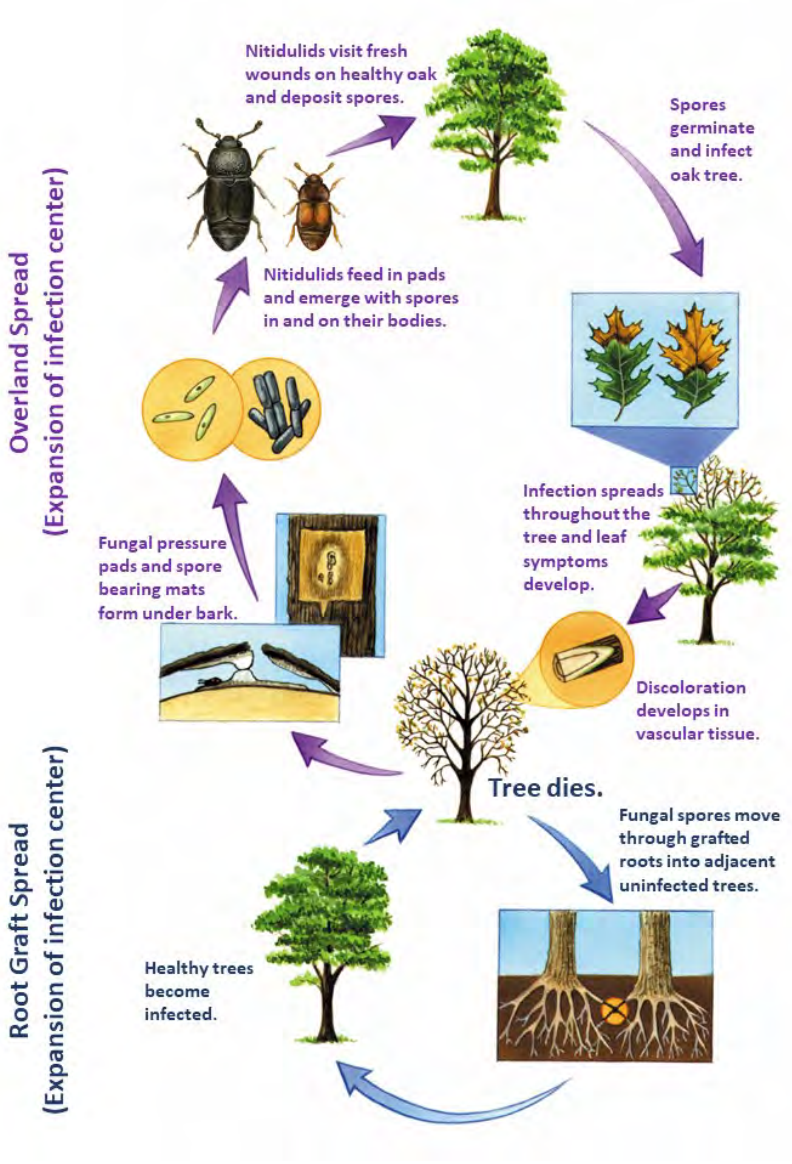


Figure 1. Oak wilt disease life cycle (O'Brien et al. 2011).

Any oaks root-grafted to infected trees have a high likelihood of dying within one to five years. Root grafts (figure 2) between red oaks are very common, and in stands with a high percentage of red oaks, all the oaks are at risk from root-to-root spread. Thus, infections normally begin with one or two infected trees and radiate out to surrounding oak trees at a logarithmically increasing rate.

Figure 2. Red oak roots actively grow together and form grafts. Photo courtesy of Ronald F. Billings, Texas A&M Forest Service, Bugwood.org.

The disease, discovered on the Chequamegon-Nicolet National Forest (the Forest) on the Lakewood-Laona Ranger District in 1997, has been treated using a number of tools analyzed in the 2011 Lakewood-Laona Oak Wilt Control Project EA. About 24 oak wilt pockets are discovered and treated annually on that district. The number of trees removed has averaged about 2,400 trees annually. The sites average 0.25 acre to 3.0 acres in size. Most sites are less than 1.0 acre (John Lampereur, Lakewood-Laona District Silviculturist, personal communication March 11, 2020). In September 2018, oak wilt disease was confirmed on the Washburn Ranger District in an isolated oak at the edge of a highway right-of-way. In 2019, the disease was confirmed at several locations on the Great Divide Ranger District in southern Bayfield County. Sites on the Washburn and Great Divide Ranger Districts have all been under one-quarter acre in size. In 2020, additional oak wilt sites were found on the Lakewood-Laona, Great Divide, and Washburn Ranger Districts. It is evident that oak wilt disease is present in widely dispersed areas across the Forest. Additional discoveries of infections are likely, so we have decided to go ahead with a Forestwide analysis for management and treatment of oak wilt disease. The project considers treatment of all known and all newly discovered oak wilt infections across the 1.5-million-acre Forest (figure 3).

PROPOSED PROJECT LOCATION

For a smaller scale map that will allow you to zoom in on specific locations, please go to the project website at: https://www.fs.usda.gov/project/?project=57903.

Figure 3. Vicinity map.

PURPOSE AND NEED FOR ACTION

The Forest has over 50,000 acres of oak-dominated forest stands, plus nearly 450,000 acres of northern hardwood stands, which often contain scattered oaks. As stated previously, oak wilt disease is a very fast killer of oak trees. A red oak infected in the spring may die within a few weeks. If no action is taken, spore mats are likely to form on the freshly killed oak the following spring, potentially threatening all oaks within about six miles (Wisconsin Department of Natural Resources [WDNR] Division of Forestry and Wisconsin Council on Forestry 2019). Controlling the disease requires prompt removal of infected trees to prevent spore production and reduce the likelihood of creating a new infection center.

Oaks also commonly form root grafts, which allow underground disease transmission from the infected tree to nearby oaks. Controlling oak wilt thus involves both removing infected trees and disrupting root grafts; if root grafts are not disrupted, the risk of underground spread to nearby oaks is very high, and the disease will continue to spread. The increasing amount of oak wilt disease on the Forest, coupled with the need to control its further spread, requires immediate action when a new oak wilt infection is found.

We propose to allow prompt treatment of oak wilt infection centers wherever found as soon as possible following discovery to slow and control the spread of oak wilt on 1.5 million acres of Forest lands. Details of how we propose to do that are explained in the Alternatives description.

TRIBAL NOTIFICATION AND PUBLIC REVIEW

Tribal entities were contacted April 1, 2020. The Tribal Historic Preservation Officer for the Forest County Potawatomi Community, Michael LaRonge, expressed concern about the amount of soil disturbance and herbicide application that have the potential to impact sites significant to the history and culture of the Potawatomi. He stated the need for a discussion of the potential impacts on Forest heritage resources of the proposed action. That discussion is included in the National Historic Preservation Act section in appendix A.

This project was placed on the Schedule of Proposed Actions April 1, 2020. We distributed a scoping package to state, Federal and local agencies, government officials, and organizations on the Forest mailing list located in the project record. A public notice was published August 15, 2020, in the newspaper of record, the *Ashland Daily Press*, announcing the beginning of a 30-day public scoping period.

Tribal entities were also contacted July 9, 2021, for review of the environmental assessment (EA). A public notice was also published July 14, 2021, in the newspaper of record, the *Ashland Daily Press*, announcing the beginning of a 30-day review and comment period of the EA.

ISSUES CONSIDERED FOR ANALYSIS

For the purposes of considering comments on an EA under the NEPA regulation, the key language is found in paragraphs two and three of 40 CFR 1501.7(a): "Determine the scope and the significant issues to be analyzed in depth in the environmental impact statement. Identify and eliminate from detailed study the issues, which are not significant or which have been covered by prior environmental review, narrowing the discussion of these issues in the statement to a brief presentation of why they will not have a significant effect on the human environment or providing a reference to their coverage elsewhere."

An interdisciplinary team of resource specialists in silviculture, wildlife, watershed, plants, soils, recreation, heritage, and timber developed the proposed action for this project. Based on discussions during proposed action development, consultation with state and county partners, public scoping comments listed in appendix B, and the experience from the 2011 Lakewood-Laona Oak Wilt Control Project EA, the interdisciplinary team identified vegetation and special management areas, including wilderness, inventoried roadless areas, and research natural areas, as issues to be analyzed in detail in this EA. The analysis areas for each resource and potential effects to each resource are defined in the Affected Environment and Environmental Consequences section.

Other issues were considered in this EA, including:

- Endangered Species Act – Threatened, Endangered, Proposed and Candidate Species and/or Critical Habitat
- Sensitive Species (Forest Service Manual 2670)
- Non-native Invasive Plant Species (Executive Order 13112, Invasive Species)
- Clean Water Act, Executive Order 11988, Floodplain Management, and Executive Order 11990, Protection of Wetlands
- Clean Air Act, including Climate Change
- National Historic Preservation Act – Section 106 Review
- Soil Resources
- Environmental Justice (Executive Order 12898)

Initial review determined that the effects to these resources were limited in extent, duration, and intensity, and did not require detailed analysis in this EA. A brief discussion of these issues is included in appendix A.

PROPOSED ACTION

This section describes the alternative analyzed in detail, the proposed action. This section also gives a brief description of alternatives or options considered but not analyzed in detail, including the no action alternative.

Standards and guidelines outlined in chapter 2 of the Forest Plan will be implemented where applicable. These standards and guidelines are in place to reduce or prevent environmental impacts. Design features created during project development to reduce or minimize impacts are also listed in appendix C. Impact analysis for the proposed action presumes that these standards, guidelines, and design features are effectively implemented along with project activities at each of the project sites.

ALTERNATIVES CONSIDERED BUT NOT ANALYZED IN DETAIL

Under the Forest Service's NEPA implementation regulations (36 CFR 220.7(b)(2)(l)), an environmental assessment need only analyze the proposed action and may proceed without consideration of additional alternatives. However, in addition to the proposed action alternative, several other alternatives were

considered. The brief analysis of those alternatives, although not detailed, provides valuable information that will be considered when deciding which action to take in the subject areas.

EXCLUSION OF INVENTORIED ROADLESS AND WILDERNESS AREAS

We considered an alternative that did not include treatment within inventoried roadless and wilderness areas to compare with the proposed action alternative. The Forest has about 100,400 acres of inventoried roadless area, 6.6% of the entire Forest, and 46,815 acres of wilderness, 3.1% of the entire Forest. Inventoried roadless areas and wilderness areas would not be treated for oak wilt disease, if discovered, and possibly would become a source of oak wilt disease for the rest of the Forest. This alternative does not meet the purpose and need of the proposed project; therefore, this alternative was not carried forward for further analysis.

NO ACTION ALTERNATIVE

Under this alternative, the proposed action would not take place. Approximately 24 oak wilt pockets have been found annually on the Lakewood-Laona Ranger District. Over the past three years 13 oak wilt pockets have been found on Great Divide and Washburn Ranger Districts. Under this alternative, treatments would not occur to control oak wilt in newly found pockets or those known from previous years. Untreated oak wilt pockets would be sources of oak wilt spores that could be spread overland to healthy oak trees by nitidulid beetles and below ground by root grafts between oak trees.

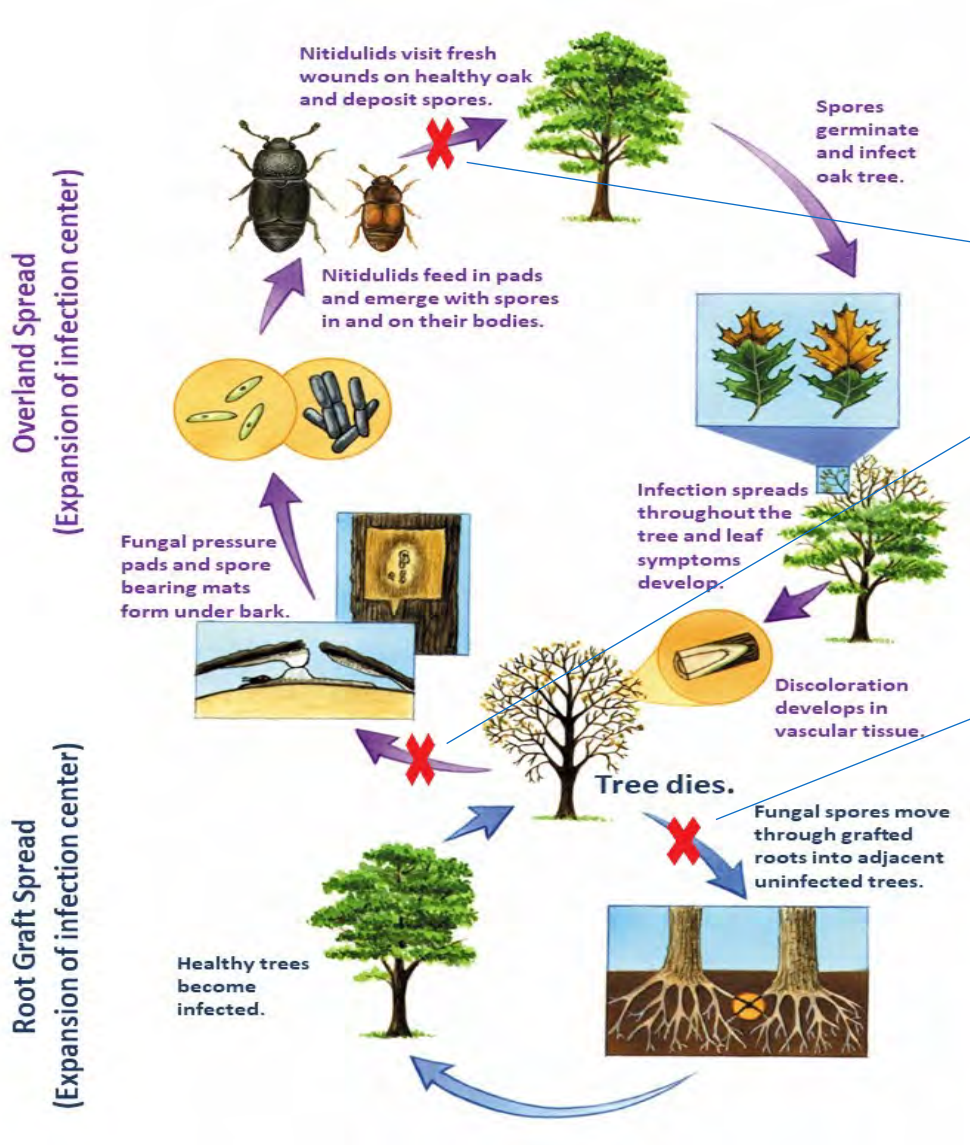
Below ground radial expansion of oak wilt through root grafts in sandy soil is estimated at 25 to 40 feet/year (Juzwik et al. 2011). Left untreated, oak wilt pockets could be expected to expand exponentially in size where root grafts to other oak trees occur. Above ground spread by nitidulid beetles that have fed on spore pads of infected oaks to oak trees damaged by spring and early summer storms would be expected. Without control measures, oak wilt could be expected to intensify and affect a greater area across the Forest.

This alternative does not meet the purpose and need of the proposed project; therefore, this alternative was not carried forward for further analysis.

ALTERNATIVE CONSIDERED IN DETAIL

PROPOSED ACTION – OAK WILT DISEASE MANAGEMENT TOOLBOX

Treatment of oak wilt will involve the removal (and treatment) of infected trees to prevent the production of spores responsible for overland spread and the installation of a root graft barrier (RGB) to prevent underground spread of the disease via root grafts to nearby oak trees. Fungicide may also be used on healthy trees to prevent infection. Monitoring will be used as a tool to help us make decisions about treatment types and timing. Points of control where management tools can be used to disrupt the disease cycle are indicated by the red X's in figure 4.



Prevent Source of Fungal Spores & Movement of Fungal Spores by Insects

Stop the establishment of new oak wilt pockets

Avoid wounds to healthy trees during active insect period.

Remove any potential spore-producing trees (PSPTs) and appropriately handle wood from diseased trees.

Disrupt Root Graft Connections

Stop the expansion of oak wilt pockets

Disrupt grafted roots to prevent belowground spread of fungus through shared vascular system.

Prevent or Arrest Development of Disease in Tree

Protect high value trees

Treat individual trees with fungicide injections.

Figure 4. Potential points of control (Adapted from O'Brien et al. 2011).

Avoid wounds to healthy trees during active insect period

Within Wisconsin there are two major climatic zones, one in southern and one in northern Wisconsin. The area between these two climatic zones is called the Tension Zone (figure 5), which bisects the state in a southeast-northwest direction (Curtis and McIntosh 1951, Curtis 1959).

Figure 5. Estimated location of the Tension Zone, adapted from Curtis (1959).

As stated in the Wisconsin Department of Natural Resources (WDNR) Oak Wilt Guide (2019), climate data and research on insect activity and fungal mat formation have shown that the risk for overland spread through fresh wounds increases significantly around April 15 north of the Tension Tone and April 1 south of the Tension Zone. Our 2004 Forest Plan guidelines limit harvesting or pruning in the red oak group to the period between October 1 and April 15 to reduce risk of oak wilt infections. Using the best available science, seasonal restrictions recommended by the WDNR Oak Wilt Guide (2019), which limit harvest north of the Tension Zone to the period between July 15 and April 15 will be followed, as will subsequent recommendations as future changes occur based on new information. This would also include no pruning of oaks during this period, or paint the wounds as quickly as possible, if pruning is necessary. If possible, construction and road building near oaks would be avoided. The final decision on whether to follow more conservative seasonal restrictions due to site-specific conditions will be at the discretion of the line officer.

Rapid response

If done very promptly, as soon as symptoms are seen in the upper crown of the infected tree but while the lower crown is still healthy, girdling plus herbicide treatment may prevent the fungus from entering the root system (Bruhn and Heyd 1992). The trees would be double girdled with a chainsaw, and herbicide would be applied to the cuts, to promptly kill the root systems. Triclopyr is the herbicide commonly used. Use of this herbicide on the Forest was analyzed in the 2005 Chequamegon-Nicolet Invasive Plant Control EA (USDA Forest Service) and a later 2011 Supplement to that EA (USDA Forest Service), so no additional analysis will be done in this EA.

Regeneration harvest

If a stand contains multiple dispersed oak wilt pockets, protection of remaining oaks in that stand from underground spread of oak wilt disease may not be feasible. A regeneration harvest, with herbicide treatment of oak stumps, can be effective to curtail ongoing oak wilt mortality contributing to ongoing production of oak wilt fungus spores on the landscape (WDNR 2019).

Natural regeneration of tree species already existing in the stand would be expected in a regeneration harvest. Tree planting could be done in stands that failed to meet post-harvest stocking guidelines for regeneration. Tree species selected for planting would be reviewed by the interdisciplinary team on a case by case basis. Risk of oak wilt regeneration would be

minimal after thorough removal of infected trees and stump treatments (Cummings Carlson et al. 2010).

Remove potential spore-producing trees

Trees killed by oak wilt in summer would be removed and treated before April 1 of the following spring, which is when new spore pads can develop. Removal and treatment of these potential spore-producing trees (PSPTs) is especially important in areas where oak wilt is rare to reduce the chances for overland spread and the creation of new oak wilt infections. Removal may be by wheeled or tracked equipment if access exists or can be developed. Where access to equipment is not possible, removal may consist of cutting the tree down and into pieces that can be handled manually.

Treatment of PSPTs could include debarking and use (processed by forest products mill) before April 1 or sanitation by one of several methods – burning, burying, chipping, splitting and drying the wood, or tarping. Covering infected wood with plastic tarps, burying the edges for six months, and then air drying for a similar time will kill the fungus and any associated insects (O'Brien et al. 2011). Trees with loose bark, killed the previous year, do not need to be removed because they can no longer produce spore pads (Cummings Carlson et al. 2010). All material greater than two inches in diameter would be treated.

In cases where harvest of the infected trees is not practical, trees would be treated by a girdle-herbicide method described below to hasten death of the above- and below-ground portions of the tree. If this is done early enough in the season, in July or early August, it can prevent formation of spore pads the following spring (Linda Haugen, Plant Pathologist, personal communication November 21, 2019).

Install root graft barrier

Containing an oak wilt pocket requires breaking the root graft connections between infected trees and nearby uninfected trees. This breaking of root-to-root connections is commonly referred to as installing an RGB. Three different techniques are commonly employed to install the RGB, depending on site conditions and the particular situation. Each is described below. Crucial to each of the techniques is that the RGB be properly located, using the method developed by Bruhn and Heyd (1992) or a comparable model. The RGB needs to surround the asymptomatic, but likely infected, adjacent oaks in addition to the infected trees to be successful (figure 6). Appendix D contains a table showing the inter-tree distances required, based on tree diameters and soil type, for proper RGB location.

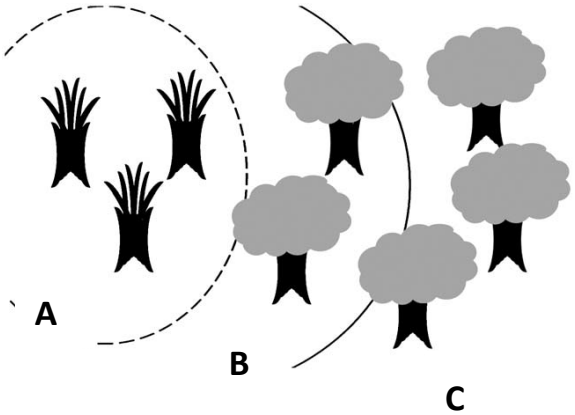


Figure 6. Dead trees at the center of the infection (A) transmit the oak wilt fungus to surrounding trees (B) via root grafts. Removing the trees in the A and B zones will normally isolate the infection, preventing spread to surrounding healthy trees (C). The size of the removal zone is determined by the diameters of the trees and the distance between them. The larger the trees, the larger the buffer zone. (Figure adapted from Koch et al. 2010)

Vibratory plow. Cutting roots with a trenching or cutting tool effectively controls the expansion of oak wilt pockets. In urban areas in the Lake States, where deep and sandy or loamy soils are common, using a vibratory plow with a five-foot blade (figure 7) is the preferred method of disrupting grafted root systems. The vibratory plow consists of a mechanical shaker unit with an attached blade that is pulled behind a tractor. The blade penetrates to a depth of about five feet, and cuts through the roots of oaks that may be grafted together. While oak roots may extend deeper than five feet in the soil, most root grafts are disrupted by trenching or plowing to that depth. Standard trenching tools do considerably more damage to the site, and the result is a much more apparent plow line than that caused by the vibratory plow (O'Brien et al. 2011).

Figure 7. The vibratory plow is a tracked or rubber-tired vehicle with a vibrating head attached at the rear. A knife-like plow blade with a slight hook at the bottom is attached to the vibrating head. The blade is pulled through the soil, slicing root connections.

Root rupture. Most of the oak wilt pockets on the Lakewood-Laona Ranger District of the Forest occurred on ground too rocky to allow effective use of a vibratory plow. Root rupture was first tried there and has been used successfully for twenty years. The location of the RGB is determined using the Bruhn-Heyd (1992) formulas described above. All oak trees within the RGB are harvested, and their stumps are promptly uprooted using an excavator or backhoe, thus breaking the root graft connections between the symptomatic infected trees and the asymptomatic, but likely infected trees, and the surrounding trees.

Although the upturning of stumps results in considerable localized soil disturbance, the method has been successful. It has often been necessary because other lower impact methods were not feasible, due to rocky soils or steep terrain. The sites treated with the root rupture method have revegetated with a high diversity of species, including oak (John Lampereur, Lakewood-Laona District Silviculturist, personal communication March 11, 2020).

Girdle or cut stump and herbicide. The girdle or cut stump and herbicide method disrupts root graft connections by killing the roots of infected, and likely infected, trees using the herbicide triclopyr (see details in the Rapid Response section). Tools used for treating SINGLE trees in the non-RGB scenarios may also be used to create an RGB of multiple asymptomatic trees. The key difference is that in RGB trees that do not yet show symptoms of oak wilt are killed to stop below ground spread. Tools used to kill trees in the non-RGB and RGB scenarios are the same. The girdle and herbicide method would be used if there are no recreational sites or buildings

nearby. If there are recreational sites or buildings nearby that could be endangered by standing dead trees, the trees would be cut down and the stumps would be treated with herbicides. The location of the RGB is determined using the Bruhn-Heyd formula (1992) as in other methods. Menominee Tribal Enterprises began using this method on tribal land on 52 oak wilt pockets starting in 2013. After five years of monitoring, 88% of these pockets were successfully contained (Haugen 2019). Further monitoring is underway on oak wilt pockets treated more recently; these results are incomplete and preliminary, but quite promising. The WDNR also has studies underway, which are not yet complete but show promise in using the girdle-herbicide method to control oak wilt pockets (Gray 2018, Progress Report).

Prevent or arrest the development of disease in a tree

Fungicide injections may be appropriate in situations where there is high disease pressure and value in preserving specific individual oak trees, such as administrative sites and unique resource areas. Fungicide use is not appropriate when the goal is eradication of the disease on a site. Species in the red oak group can be macro-injected with the systemic fungicide propiconazole to prevent development of oak wilt symptoms. A single preventive treatment protects trees for about two years. Long-term protection will require repeated injections. Fungicide does not prevent below ground spread of oak wilt and is often combined with other treatment options as part of a comprehensive site-specific response.

Monitoring

Choosing to monitor an infection instead of using one of the other management tools may be appropriate in some situations:

- The risk of oak wilt spread is low because the tree is isolated in a species-rich forest or no infected oaks are within root grafting distance of any healthy oaks.
- Adverse impacts to other resources, including but not limited to, streams, wetlands, nests or denning sites, or heritage resources, from use of other management tools outweigh the benefits of treatment. Use of another management tool may change the values or ability to retain the characteristics for which a management area was designated.
- The site is very remote and inaccessible.

Management of oak wilt disease is not “One Size Fits All”

Factors that affect management include:

- Prevalence of oak wilt disease in the vicinity: When the disease is uncommon in an area, it is prudent to be aggressive in management to keep it uncommon. Prompt removal of PSPTs is crucial.
- Soil type and stand composition: Oak wilt disease is known to spread to adjacent oaks through connected/grafted roots, and these grafts are more common in sandy soils with continuous oak cover type. Inversely, root graft transmission does not occur as consistently on loamy soils and in diverse forest types with mixtures of other species in

between the oaks. If soils are too stony, the use of equipment like a vibratory plow, is not feasible.

- Access: If the oak wilt pocket is located in a remote area inaccessible to heavy equipment, the type of treatment will change accordingly.
- Number of trees: If we only have a few trees that need treatment, harvest or root rupture methods may not be feasible. If enough trees needing treatment are nearby, harvest and root rupture become practical.
- Size of trees: Big trees have bigger root systems and are more likely to connect to trees that are farther away.
- Age of infection/Stage of development: If very recently infected, rapid response techniques may prevent disease from entering the root system.
- Management objectives: On some sites, each individual tree is highly valued for historic or other reasons, while on other sites it is quite acceptable to "sacrifice" some trees. On some sites, there is ability/desire to market the oak resources, on other sites there is not.
- Capacity for ongoing monitoring and response: Some managers have an existing contract or other means of responding rapidly to a discovery of oak wilt; others cannot respond quickly. On some sites, observers are present throughout the season and can easily monitor for development of disease symptoms on additional trees, whereas on other sites there is no capacity for continuous monitoring (Haugen 2019).

The following trigger points would be used to initiate treatment on stands in monitor status (previously known infection sites) and newly discovered infection sites:

- An active oak wilt infection is present;
- Live, healthy oaks with infection potential via root graft surround the infected tree(s);
- There are no extraordinary circumstances present that would result in adverse environmental effects. This criterion would be determined on a case-by-case interdisciplinary review.

If a new infection is found anywhere on the Forest, the site would be reviewed by an interdisciplinary team to identify potential resource concerns and the best method of treatment, if any. If no concerns are found, the site would be treated to remove the infection. If concerns are found, the team would work together to avoid or minimize impacts, or no treatment would be done.

The choice of management tool to use depends on several factors described above and is outlined as follows in table 1.

Oak wilt occurrence and treatment on the Forest will be documented and monitored. Revisiting a site during the summer and checking nearby oaks for disease symptoms remains the most effective way of determining whether an oak wilt pocket has been successfully contained.

Monitoring, and potentially, retreatment, would be done for at least five years following the initial treatment. If one management tool does not work, others may be used, depending on the factors described above.

The tougher challenge is efficiently detecting new infections in remote areas. Aerial detection flights are usually flown at too high of an altitude and too wide a flight pattern to pick up one or two dead or dying oaks in a new oak wilt pocket. However, research is underway regarding the use of satellite imagery to detect oak wilt (Sarah Wegmueller, Graduate Student of Forest Pathology, University of Wisconsin, personal communication June 20, 2019), and some managers are using drones to search for new oak wilt infections (Linda Haugen, Plant Pathologist, personal communication November 21, 2019).

Pathologists from Forest Health Protection, a part of State and Private Forestry, USDA Forest Service, provided technical guidance in the development of this proposed action and will continue to play an integral role in the monitoring, identification, and treatment of oak wilt on the Forest.

Table 1. Field situation and what management tool to use.

	Situation		Control Options		Management Area Recommendations	TES Recommendations
Prevent Spore Production Responsible for Overland Spread Situations where RGB are either not appropriate or not necessary.	A **single** oak wilted in the spring or summer, and no other dead oaks are nearby. Evidence of early detection of overland infection.		rapid response treatment of only one symptomatic oak	herbicide (girdle or cut stump)	May be applied in Federal Wild, Scenic, Recreation, and State Wild River segments and wilderness with use of design features listed in appendix C.	
				root rupture/stump extraction	May not be applied within Federal Wild River segments. May be applied in Federal Scenic, Recreation, and State Wild River segments with use of design features listed in appendix C. Do not apply in management areas 8E, 8F, 8G and wilderness.	Do not apply within 250 feet of TES plant population. Do not apply (from April 1 to October 1) within 300m of stream channels that have mapped wood turtle habitat.
	Wilting oaks are isolated in a species-rich forest; no diseased oaks are within grafting distance of any healthy oaks that are grafted to diseased oaks.		sanitation only; remove and destroy infected trees as described in Remove Potential Spore-Producing Trees section.		May not be applied within Federal Wild River segments. May be applied in Federal, Scenic, Recreation, and State Wild River segments with use of design features listed in appendix C. If applied in management areas 8E, 8F, and G, infected trees should be sanitized in place as described in Remove Potential Spore-Producing Trees section. May not be applied in wilderness.	Keep heavy equipment out of mapped wood turtle habitat (300m from stream course) from April 1 to October 1.
	Disease is widespread throughout the stand, making control of individual pockets prohibitive.		stand replacement/ regeneration harvest		May not be applied within Federal Wild River segments. May be applied in Federal Scenic, Recreation, and State Wild River segments with use of design features listed in appendix C. Do not apply this option in management areas 8E, 8F, 8G and wilderness.	Do not apply within 250 feet of TES plant population. Do not apply (from April 1 to October 1) within 300m of stream channels that have mapped wood turtle habitat.
Treatments involving establishment of an RGB (e.g. asymptomatic buffer trees included in treatment to halt below ground spread)	Site is accessible to larger equipment and…	… vibratory plow or trencher is available; soils are deep and infrastructure is not buried.	vibratory plow		May not be applied within Federal Wild River segments. May be applied in Federal, Scenic, Recreation, and State Wild River segments with use of design features listed in appendix C. Do not apply in management area 2B, due to summer ground disturbance, or in management areas 8E, 8F, and 8G.	Do not apply within 250 feet of TES plant population. Do not apply (from April 1 to October 1) within 300m of stream channels that have mapped wood turtle habitat.
		… soils are shallow or rocky and/or infrastructure prohibits trenching.	root rupture			
	Equipment (vibratory plow/ excavator) is not available, or soil disturbance is undesirable and…	… short term presence of girdled trees is acceptable.	girdle and herbicide trees around infected tree	with tree removal after brown-up	May not be applied within Federal Wild River segments. May be applied within Federal Scenic, Recreation, and State Wild River segments with use of design features listed in appendix C. Do not apply in management areas 8E, 8F, and 8G.	Do not apply within 250 feet of TES plant population. Keep heavy equipment out of mapped wood turtle habitat (300m from stream course) from April 1 to October 1.
		… whole tree felling is undesirable; remote sites.		without tree removal	May be applied in Federal Wild, Scenic, Recreation and State Wild River segments. May be applied in management areas 8E, 8F, 8G and wilderness.	
		… recreational sites or other factors that make standing girdled trees unsafe.	cut stump herbicide		May not be applied within Federal Wild River segments. May be applied in Federal, Scenic, Recreation and State Wild River segments. Do not apply in management Areas 8E, 8F, 8G or wilderness, unless essential for safety.	

	Situation	Control Options	Management Area Recommendations	TES Recommendations
Fungicide	High disease pressure and there is value in preserving specific individual oak trees, such as administrative sites and unique resource areas.	fungicide injection	May be allowed within Federal Wild, Scenic, Recreation and State Wild River segments with use of design features listed in appendix C. Do not apply this option in management areas 8E, 8F, 8G and wilderness.	
No Treatment	Risk of spread is low and/or impacts are expected to be low. Treatment may not be effective or adverse effects to other resources may outweigh the benefits of treatment. The site is very remote and inaccessible.	monitoring only	In management areas 8E, 8F, 8G, and wilderness, this will be the default response unless the interdisciplinary team determines that active management is recommended.	In TES plant sites, this will be the default response unless the interdisciplinary team determines that other active management is recommended.

AGENCIES & PERSONS CONSULTED OR CONTACTED

Given the nature of the project, the Responsible Official consulted the following agencies, organizations, tribes and persons during development and analysis. The mailing list is available in the project record.

Agencies

U.S. Fish and Wildlife Service

Organizations/Businesses

American Woodcock Society

Chequamegon Area Mountain Bike Association

Environmental Law & Policy Center

Federal Sustainable Forest Committee

Forest Resources Association, Lake States Region

Great Lakes Indian Fish and Wildlife Commission

Great Lakes Timber Professionals Association

Happy Hikers

Healthy Forests, Healthy Communities

Ice Age Trail Alliance

Lakes States Lumber Association

Lake States Resources Alliance

Midwest Forest Products

North Country Trail Association

Rock Mountain Elk Foundation, Inc.

Ruffed Grouse Society

Sustainable Forestry Initiative, Inc.

Tad Deer Management LLC

The Nature Conservancy

Various snowmobile associations (see project record for complete list)

Westboro Fish and Wildlife Club

Wisconsin ATV Association

Wisconsin County Forests Association

Wisconsin Hunter's Rights Coalition

Wild Rivers Trout Unlimited

Wisconsin Sharp-tailed Grouse Society

Wisconsin ATV-UTV Association

Wisconsin Paper Council

Woodside Cottages

Native American Tribes

Bad River Band of Lake Superior Chippewa Indians

Bay Mills Indian Community

Fond du Lac Band of Lake Superior Chippewa

Forest County Potawatomi Community

Ho-Chunk Nation of Wisconsin

Keweenaw Bay Indian Community

Lac Courte Oreilles Band of Lake Superior Chippewa Indians

Lac du Flambeau Band of Lake Superior Chippewa Indians

Lac Vieux Desert Band of Lake Superior Chippewa Indians

Menominee Indian Tribe of Wisconsin

Mille Lacs Band of Ojibwe

Oneida Indian Nation of Wisconsin

Red Cliff Chippewa Tribe

Sakaogon Chippewa Community Mole Lake Band of Lake Superior Chippewa

St. Croix Chippewa Indians of Wisconsin

Stockbridge-Munsee Band of Mohican Indians

Wisconsin Tribal Conservation Advisory Council

State/Local Governments

State Historic Preservation Office

Wisconsin Department of Natural Resources

County Officials (see project record for complete list)

Town Officials (see project record for complete list)

Elected Officials

Federal and State Congressional representatives contacted are listed in the project record.

Individuals

Individuals contacted are listed in the project record.

ENVIRONMENTAL IMPACTS REVIEW

The following effects (or impacts) discussions focus on changes to the human environment from the proposed action (or alternatives) that are reasonably foreseeable and have a reasonably close causal relationship to the proposed action or alternatives, including those effects that occur at the same time and place as the proposed action (or alternatives) and may include effects that are later in time or farther removed in distance from the proposed action or alternatives.

VEGETATION AFFECTED ENVIRONMENT

Oak wilt can occur anywhere oak trees are present; therefore, the proposed action may treat oak wilt in any forest type or location. The locations oak wilt has been found on the Forest range widely from an isolated tree along a highway, to a campground, to stands dominated by northern red oak. All oak wilt infected trees are a source of inoculum for future infections, regardless of their location. Overland and below ground transmission of oak wilt were displayed previously in figure 1.

The potential for losses to oak wilt increase with increasing density of oak within a stand. The following information is shared for perspective on the oak resource present on the Forest. Over 50,000 acres of stands have oak as the primary species or secondary species. Primary being stands where oak represents at least half of the stocking. In secondary stands, oak represents less than half of the stocking but is still found throughout the stand. Primary and secondary oak stands represent about 4% of the 1.5 million-acre Chequamegon-Nicolet National Forest. The Washburn Ranger District has the largest area of oak forest with about 62% of the Forest total. Table 2 shows the distribution of oak across all ranger districts.

Table 2. Summary of oak forest type by district.

District	Oak Component	Forest Type	Acres
Medford-Park Falls	Primary	Oak-aspen	74
		Northern red oak	58
		Oak-hardwoods	231
	Primary Total		**363**
	Secondary	Sugar maple-northern red oak	21
	Secondary Total		**21**
Medford-Park Falls Total			**384**
Great Divide	Primary	Oak-eastern white pine	24
		Oak-aspen	101
		Northern red oak	1,748
		Oak-hardwoods	2,073
	Primary Total		**3,946**
	Secondary	Eastern white pine-northern red oak/white ash	70
		Red pine-oak	12
		Sugar maple-northern red oak	264
	Secondary Total		**346**
Great Divide Total			**4,292**

District	Oak Component	Forest Type	Acres
Eagle River-Florence	Primary	Oak-eastern white pine	114
		Northern red oak	924
		Oak-hardwoods	208
	Primary Total		**1,246**
	Secondary	Eastern white pine-northern red oak/white ash	100
		Red pine-oak	33
		Sugar maple-northern red oak	5
	Secondary Total		**138**
Eagle River-Florence Total			**1,384**
Lakewood-Laona	Primary	Oak-eastern white pine	102
		White oak	6
		Northern red oak	10,541
		Northern pin oak	582
	Primary Total		**11,231**
	Secondary	Eastern white pine-northern red oak/white ash	825
		Jack pine-oak	587
		Red pine-oak	502
	Secondary Total		**1,914**
Lakewood-Laona Total			**13,145**
Washburn	Primary	Oak-eastern white pine	386
		Oak-aspen	2,659
		Northern red oak	25,251
		Mixed oaks	101
		Oak-hardwoods	2,568
		Northern pin oak	2,124
	Primary Total		**33,089**
	Secondary	Eastern white pine-northern red oak/white ash	22
		Jack pine-oak	427
		Red pine-oak	303
		Sugar maple-northern red oak	243
	Secondary Total		**995**
Washburn Total			**34,084**
Chequamegon-Nicolet National Forest Total			**53,289**

While oak stands cover only 4% of the Chequamegon-Nicolet National Forest, 86% of those stands are older than 80 years (table 3). Older stands typically have more large trees than younger stands. Large oak trees tend to have larger root systems, which are more likely to be grafted to surrounding oak trees.

Table 3. Distribution of age classes of primary and secondary oak forest type stands.

Age	Acres	Percent
0-19	1,567	3
20-59	2,637	5
60-79	3,156	6
80+	45,927	86

Oak is a valuable species, both in terms of its habitat value to wildlife and in terms of its economic value to people. It is normally found in stands where most trees are the same age that regenerated following large disturbances. Much of the oak on the Forest originated in the 1920's and 1930's following landscape level timber cutting, also known as the "great cutover."

The Lakewood-Laona Ranger District has been discovering about 24 oak wilt pockets annually. While oak wilt was first found on the Washburn Ranger District in 2018 and on the Great Divide Ranger District in 2019, each of the past two years there have been six oak wilt infections between the two districts. Based on recent experience, the Forest can expect about 30 new oak wilt infections per year. Over the past two decades on the Lakewood-Laona Ranger District, most sites have been less than one acre. On other districts all sites have been under one-quarter acre.

VEGETATION EFFECTS DISCUSSION

In the proposed action, the Forest Service would have the ability to treat all identified oak wilt infection centers at risk of outward expansion. In such a scenario, it can be assumed that all known infections would be treated in the short term. If needed, follow-up treatments would also be employed. Long term monitoring on the Lakewood-Laona Ranger District has shown oak wilt infections are controlled 95% of the time with two treatments or less. It can be assumed that the remaining uncontrolled infections would receive additional treatments in successive years until it is brought under control.

With prompt treatment of oak wilt infections, the disease can be managed and losses to the Forests oak resource could be minimized (Juzwik et al. 2011). Without prompt treatment of new oak wilt infection sites, the yearly number of new sites would be expected to rise as more inoculum would be present for overland spread. The number of new infection sites would be dependent on several factors, including injury to oaks when nitidulid beetles are actively feeding and the number of oak trees in the area. Oak wilt infection sites established in stands of oak would also be expected to grow in size through below ground root grafts, if no treatment measures were taken. Below ground spread of oak wilt is typically less than 50 feet per year in the Midwest (Wilson 2001). The size growth of existing infection sites would depend on the number of oak trees root grafted to infected trees and wounds to healthy trees during times when nitidulid beetles are active.

Table 1 would be used to guide treatment decisions. Treatments would be focused on containing oak wilt infections as soon as they are discovered. These methods are effective at protecting the oak

resource. They manage oak wilt to prevent expansion of the disease, reducing the area of forest impacted.

In stands of oak where oak wilt is widespread, it may not be feasible to contain each infection center due to overlapping root zones from one infection center to another. In this scenario a regeneration harvest would be considered. The future stand composition will depend on the current species make up. A stand dominated by oak is likely to be regenerated back to oak if oak seedlings and saplings are present. Stands of mixed species are likely to remain stands of mixed species as a variety of species capitalize on increased light and nutrient availability created by the disturbance in the oak overstory.

Planting may be considered in the event of a regeneration harvest where regeneration fails to meet regeneration stocking guidelines (USDA Forest Service 2004). Species selected for planting may include oak or other species for site diversification. Once a site is successfully treated, oak wilt risk to oak regeneration is minimal.

All treatment actions, as depicted in table 1, would follow Forest Plan standards and guidelines. No effect on Forest Type Composition objectives identified in the 2004 Forest Plan are expected due to the small amount of area expected to be treated each year. Less than 0.001% of the area classified as oak forest has been treated on an annual basis in previous years.

As listed on page 12, all treatments would be monitored for at least five years. If a treatment fails to control oak wilt, subsequent treatments would be considered. Experience on the Lakewood-Laona District shows that 5% of oak wilt sites may require more than two treatments. This would be about one to two sites per year at the current average of 30 oak wilt sites per year on the Forest. Each time a site is evaluated for treatment all treatment tools (table 1) would be considered. Treating a site more than once is not expected to have an effect on Forest Type Composition objectives.

Oak wilt is known to occur on other public and private lands surrounding the National Forest. Federal, State, and other land management forest health staff communicate and regularly share information on oak wilt locations as well as treatment plans. Sharing resources, such as aerial survey information and public reports of oak wilt, are expected to continue to be important to managing oak wilt across the landscape.

NATIONAL FOREST MANAGEMENT ACT (NFMA) – LAND MANAGEMENT PLAN CONSISTENCY

The pertinent specialists have reviewed the project and made the following determinations regarding consistency with applicable Land Management Plan direction, standards and guidelines.

Botany: Consistent

Cultural/Heritage: Consistent

Engineering: N/A

Fisheries: Consistent

Fuels: Consistent

Hydro: Consistent

Recreation: Consistent

Scenic Resources: Consistent

Soils: Consistent

Silviculture: Consistent

Special Management Areas (Inventoried Roadless Areas, Wilderness, Special Management Areas, and Research Natural Areas: Consistent

Wildlife: Consistent

SUPPORTING PROJECT DOCUMENTATION

Table 4. Applicable project file documentation to support NFMA compliance.

Documentation Type	File Name (if applicable/needed)
Preliminary Effects Worksheet – RFFS Plants, Oak Wilt EA	EffectsWorksheetRfssPlants.docx
Preliminary Effects Worksheet – Natural Areas (MA 8EFG)	Effects_Worksheet_Natural Areas.docx
Preliminary Effects Worksheet - Soils	OakWilt Soils Pre-Effects_Worksheet_v3.docx
Preliminary Effects Worksheet – Non-native Invasive Plant (NNIP) infestation and/or spread	preEffectsWorksheetNNIP.docx
Preliminary Effects Worksheet – Change in Vegetation Condition	Pre_Effects_Worksheets_Silviculture.docx
Preliminary Effects Worksheet – Impacts to Wood Turtle (RFSS)	Pre_Effects_Worksheets_wood_turtle.docx
Preliminary Effects Worksheet – Northern long-eared bat (threatened), Big brown bat (RFSS), Little brown bat (RFSS) and Tri-colored bat (RFSS)	Pre_Effects_Worksheet_bats.docx
Preliminary Effects Worksheet – Natural Areas (MA 8EFG) (often referred to collectively as Ecological Reference Areas or Natural Areas)	Pre_Effects_Worksheet_Natural Areas.docx
Preliminary Effects Worksheet – Red-shouldered hawk (RFSS)	Pre_Effects_Worksheet_RSH.docx
Preliminary Effects Worksheet – Water Quality	Pre_Effects_Worksheet_WaterQuality_032520.docx

SPECIAL MANAGEMENT AREAS (E.G. WILDERNESS, ROADLESS, RESEARCH NATURAL AREAS)

The pertinent specialists have reviewed the project and made the following determinations based on special management area presence/proximity or lack of:

Table 5. Special management area compliance determinations.

Management Area Type	Applicable Law/Regulation to Demonstrate Compliance With	Rationale for Compliance or Needs for Project Modification
Wilderness and Wilderness Study Areas	The Wilderness Act of 1964	There are no valid existing rights or special provisions in the Wilderness Act (1964) that specifically allows consideration of any of the Section 4c prohibited uses. However, the following sections form the basis for the analysis. Section 2(a) Wilderness “shall be

Management Area Type	Applicable Law/Regulation to Demonstrate Compliance With	Rationale for Compliance or Needs for Project Modification
		administered . . . in such manner as will leave them unimpaired for future use as wilderness, and so to provide for the protection of these areas [and] the preservation of their wilderness character . . . " Section 2(c) An area of wilderness is . . . an area of undeveloped Federal land retaining its primeval character and influence, without permanent improvements or human habitation, which is protected and **managed so as to preserve its natural conditions** and which (1) generally appears to have been affected primarily by the forces of nature, with the imprint of man's work substantially unnoticeable . . ." Section 4(c) Prohibition of certain uses ". . . there shall be no temporary road, no use of motor vehicles, motorized equipment or motorboats, no landing of aircraft, no other form of mechanical transport, and no structure . . . "
Inventoried Roadless Area	Roadless Area Conservation Rule	Per 36 CFR 294.13, Prohibition on timber cutting, sale, or removal in inventoried roadless areas. (b)(1) The cutting, sale, or removal of generally small diameter timber is needed for one of the following purposes and will maintain or improve one or more of the roadless area characteristics as defined in 294.11 (ii) *To maintain or restore the characteristics of ecosystem composition or structure . . . within the range of variability that would be expected to occur under natural disturbance regimes of the current climatic period.*
Research Natural Area	2004 Land and Resource Management Plan	Oak wilt management control options have been narrowed down to removal of potential spore-producing trees, girdle or cut stum and herbicide, and monitoring.

SUPPORTING PROJECT DOCUMENTATION

Table 6. Applicable project file documentation to support special management area compliance.

Documentation Type	File Name(s)
Minimum Requirements Decision Guide Workbook	20210219OakWiltMRDG_workbook.xlsx
R9 Roadless Briefing Paper 2001 Roadless Rule for Oak Wilt Disease Management	2021CNNFForestwideOakWiltMgmtATTACHMENT 3 – R9 Roadless Rule Briefing Paper.docx
National Research Natural Area (RNA) Program USDA Forest Service Eastern Region Northern Research Station RNA USE APPLICATION and APPROVAL FORM	CNNFForestwideOakWiltNRS_rna-research-request-form_ver20210128.docx

INTERDISCIPLINARY TEAM MEMBERS

Specialist	Resource Area
Mark Farina, Forest Soil Scientist	Soils
Bill Baer, Forest Planning Biologist	Wildlife, including TES species
Linda Parker, Forest Ecologist	Ecology, including Special Management Areas
Steven Spickerman, Great Divide District Ecologist	Ecology
Tim Vetter, Recreation, Wilderness and Lands Program Manager	Wilderness and Inventoried Roadless Areas
Sue Reinecke, Forest Fisheries Biologist	Fisheries, Watershed and Wild and Scenic Rivers
Gerred Carothers, Great Divide District Silviculturist	Silviculture and Forest Health
Matt Bushman, Forest Silviculturist	Silviculture and Forest Health
Jerry VanCleve, Forest Silviculturist	Silviculture and Forest Health
John Schmidt, GIS Specialist	GIS
Linda Haugen, Plant Pathologist, State and Private Forestry, St. Paul Field Office	Plant Pathology and Forest Health
Ginger Molitor, Great Divide District NEPA Coordinator	Team Leader and NEPA Coordinator
Mike Martin, Great Divide District Ranger	Line Officer
Paul Strong, Forest Supervisor	Deciding Official

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APPENDIX A – OTHER ISSUES

Other issues were considered in this EA, including:

- Endangered Species Act – Threatened, Endangered, Proposed and Candidate Species and/or Critical Habitat
- Sensitive Species - Forest Service Manual 2670
- Non-native Invasive Plant Species - Executive Order 13112, Invasive Species
- Water Resources - Clean Water Act, Executive Order 11988 - Floodplain Management, and Executive Order 11990 - Protection of Wetlands
- Air Quality, including Greenhouse Gas Emissions - Clean Air Act
- Heritage Resources - National Historic Preservation Act – Section 106 Review
- Soil Resources
- Environmental Justice - Executive Order 12898

ENDANGERED SPECIES ACT

THREATENED, ENDANGERED, PROPOSED AND CANDIDATE SPECIES &/OR CRITICAL HABITAT

The pertinent specialists reviewed the project and made the following determinations for threatened, endangered and/or proposed species:

Botany: No threatened, endangered, proposed, candidate (TEPC) plant species or habitat are known to occur in the project areas.

Wildlife: Threatened, endangered, proposed and candidate species or habitat occur in the project area. U.S. Fish and Wildlife Service (FWS) consultation has occurred. The biological evaluation (BE) located in the project record includes details on potential occurrence of habitat in the proposed project area. Because it is not specifically known where infection sites will occur, the analysis will rely on district knowledge of species, habitat use, past surveys and previous project assessment to determine which species to analyze. Additional surveys specifically for this project will be done at the time when new infection sites are discovered. Nevertheless, it is important to discuss the potential impacts to a few species known to inhabit potential areas prior to an infection outbreak. Potential impacts to three federally-listed threatened and endangered species were evaluated in detail in the BE. See table 7 below.

Table 7. TEPC effect determinations for ESA.

Species/Habitat	Status	Proposed or Designated Critical Habitat Present?	Determination*	Brief Rationale (or refer to other project documentation)
Canis lupis – Gray (Timber) wolf	State threatened	No	NE	Wolves would temporarily avoid treatment areas while operations occur. Temporary suitable habitat disturbance.
Lynx canadensis – Canada lynx	Threatened	No	NE	No suitable habitat on the Forest.
Myotis septentrionalis – Northern long-eared bat	Threatened	No	LAA, but No Jeopardy	Temporary disturbance to bats during implementation. If roost tree discovered, activities will be modified to protect roost tree. Based on past experience, it is assumed project would treat about 24 non-contiguous acres per year, which would be temporary impact to suitable habitat.

***NE** – No Effect; **NLAA** – May Affect, Not Likely to Adversely Affect; **LAA** – May Affect, Likely to Adversely Affect; **No Jeopardy** - Not Likely to Jeopardize the Continued Existence or Adversely Modify Critical Habitat

SUPPORTING PROJECT DOCUMENTATION

Table 8. Applicable project file documentation to support ESA compliance.

Documentation Type	File Name (if applicable/needed)
Biological Evaluation (Plants) Project: 2020 Oak Wilt Disease Management	bioEvalPlants_oakWilt3112020draft.docx
Biological Evaluation (Short Form) Oak Wilt Disease Management Project	Oak Wilt BE Short Form Final 04202020.docx

SENSITIVE SPECIES (FSM 2670)

The pertinent specialists reviewed the project and made the following determinations for sensitive species:

Potential impacts to Regional Forest sensitive species were evaluated in more detail in the BEs listed in table 8.

Botany: See probable occurrence and habitat potential for species analyzed in detail in table 9 below. Plant species displayed in table 9 as "Probable" are all species found in dry-mesic to mesic forested habitats which may be dominated by northern red oak, northern pin oak or have oak as a component of the stand. Because future oak wilt sites are unknown at this time, it is not known whether Regional Forester sensitive species plants (previously documented or yet to be discovered) would be affected. It is also not possible to calculate the acreage of suited habitat that may become unsuited due to activities associated with the project. As stated in the proposed action, if a new infection is found anywhere on the Forest in the future, the site will be reviewed by an interdisciplinary team to identify potential resource concerns. At that point, the area will be surveyed for sensitive plant species, and determinations will be made.

Aquatics and Wildlife: See determinations for species analyzed in detail in table 9 below.

Table 9. Sensitive species habitat potential and determinations.

Species	Determination*	Rationale (or refer to other project documentation) or Occurrence or Habitat Potential for Plant Species
Arabis missouriensis var. *deamii* – Missouri rock cress	Choose an item.	Probable means that habitat is suitable, species has been documented on the Forest but not necessarily within project/proposed project area. Likelihood of occurrence is high.
Botrychium minganense – Mingan's moonwort	Choose an item.	Probable.
Botrychium mormo – Goblin fern	Choose an item.	Probable.
Botrychium oneidense – Blunt-lobed grapefern	Choose an item.	Probable.
Carex backii – Rocky mountain sedge	Choose an item.	Probable.
Juglans cinerea - Butternut	Choose an item.	Probable.
Panax quinquefolius – American ginseng	Choose an item.	Probable.
Piptatherum canadensis – Canada mountain - ricegrass	Choose an item.	Probable.
Vaccinium cespitosum – Dwarf bilberry	Choose an item.	Probable.
Buteo lineatus – Red-shouldered hawk	NI	Forest Plan guidelines to protect active and historic nest sites will be followed but may be altered based on site-specific conditions.

Species	Determination*	Rationale (or refer to other project documentation) or Occurrence or Habitat Potential for Plant Species
Eptesicus fuscus – Big brown bat	MIIH	This species may be roosting with non-volant young in snags and damaged trees during the treatment period and could be impacted. Conservation measures for northern long-eared bats would also be protective of this species.
Glyptemys insculpta – Wood turtle	MIIH	Potential impacts during oak wilt treatment within wood turtle habitat buffers. Design features will be implemented.
Haliaeetus leucocephalus – Bald eagle	NI	Forest Plan standards and guidelines to protect eagle nests would be implemented, if one should occur in the project area.
Martes americana – American marten	NI	The project will treat about 24 acres per year over the entire 1.5-million-acre Forest. Due to the small scale of the project the effects to marten cannot be meaningfully measured.
Myotis lucifugus – Little brown myotis	MIIH	This species may be roosting with non-volant young in snags and damaged trees during the treatment period and could be impacted. Conservation measures for northern long-eared bats would also be protective of this species.
Perimyotis subflavus – Tri-colored bat	MIIH	This species may be roosting with non-volant young in snags and damaged trees during the treatment period and could be impacted. Conservation measures for northern long-eared bats would also be protective of this species.
Pieris virginiensis – West Virginia white	NI	Species is known to occur on the Forest and is likely to be widespread given the large amount of suitable habitat on the Nicolet land base. Toothwart, the known host plant for caterpillars, will be protected.

* NI – No Impact; MIIH- May Impact Individuals or Habitat, but Will Not Likely Contribute To A Trend Towards Federal Listing Or Loss Of Viability To The Population Or Species; WIFV - Will Impact Individuals or Habitat with A Consequence That the Action May Contribute To A Trend Towards Federal Listing Or Cause A Loss Of Viability To The Population Or Species

SUPPORTING PROJECT DOCUMENTATION

Table 10. Applicable project file documentation to support agency sensitive species compliance.

Documentation Type	File Name (if applicable/needed)
Biological Evaluation (Plants) Project: 2020 Oak Wilt Disease Management	bioEvalPlants_oakWilt3112020draft.docx
Biological Evaluation (Short Form) Oak Wilt Disease Management Project	Oak Wilt BE Short Form Final 04202020.docx

NON-NATIVE INVASIVE PLANT SPECIES - EXECUTIVE ORDER 13112, INVASIVE SPECIES

The pertinent specialist reviewed the project and made the following determination:

Invasive plants on the Forest are inventoried, monitored, and treated on an ongoing basis using several methods, and the majority of documented non-native invasive plant sites within the Forest have had treatment in past years. A previously approved Forest-wide decision specific to invasive plants cover non-native invasive plants within the project area. Work to inventory, monitor, and control invasive plants will continue within the Forest regardless of any decisions made through this project. Forest Plan standards and guidelines and design features listed in appendix C will be implemented, thus avoiding and minimizing adverse impacts as much as possible.

WATER RESOURCES - CLEAN WATER ACT, EXECUTIVE ORDER 11988 - FLOODPLAIN MANAGEMENT, EXECUTIVE ORDER 11990 - PROTECTION OF WETLANDS

The pertinent specialist has reviewed the project and made the following determination:

Proposed activities adjacent to riparian areas and wetlands would follow best management practices for water quality, as well as Forest Plan standards and guidelines for wildlife, fish, soil, and water resources. Best management practices, when properly implemented, would ensure project activities would not cause long-term impacts to water quality.

The effect to water quality from proposed activities would not impair the long-term water quality. These assumptions are based on the finding of past timber sales where the ground cover is maintained by residual vegetation and logging slash and areas where the soil is exposed, revegetation typically occurs quickly (USDA 2001). In addition, best management practice monitoring has been completed nine times across various land ownerships (State, County, Federal, industrial, and private lands) to evaluate the success of the program. The most recent monitoring on Federal and industrial timber sales was done in 2014 where 29 timber sales were monitored throughout the Forest. Overall best management practice application rates on Federal lands have significantly improved since the start of the monitoring program. The highest percentage rate of correctly applied best management practices was riparian management zones at 100%. For a more in-depth analysis of the monitoring results, see Appendix F of the Implementation and Effectiveness of Wisconsin's Forestry Best Management Practices for Water Quality on the Chequamegon-Nicolet National Forest, 1995-2014. Moreover, according to the 2010 Wisconsin Statewide Forest Assessment the Wisconsin Department of Natural Resources best management practices program is considered a success as studies have shown that silviculture is not a significant source of water quality impairment in Wisconsin (WDNR 2010).

Supporting Project Documentation

Table 11. Applicable project file documentation to support agency sensitive species compliance.

Documentation Type	File Name (if applicable/needed)
Preliminary Effects Worksheets – Water	Pre_Effects_Worksheet_WaterQuality_032520.docx

AIR QUALITY, INCLUDING GREENHOUSE GAS EMISSIONS - CLEAN AIR ACT (CAA)

The pertinent specialist has reviewed the project and made the following determinations regarding the CAA:

Pollutants and greenhouse gas emissions from oak wilt treatment equipment and transport would have effects on air quality. These activities would produce nitrogen oxides, sulfates, and particulate matter $(PM)_{2.5}$, http://www.ucsusa.org/clean_vehicles/why-clean-cars/air-pollution-and-health/trucks-buses-and-other-commercial-vehicles/diesel-engines-and-public.html#Solutions

However, it is highly unlikely that emissions from these sources would be generated in high enough quantities to be detected by the closest air quality monitoring stations in Odanah, Perkinstown, Boulder Junction, Rhinelander, and Crandon, given the amount of logging activities in northern Wisconsin in the past have not triggered a 24-hour or annual breach of the National Ambient Air Quality Standards.

The Prevention of Significant Deterioration (PSD) program set all land in the United States as Class II, accommodates a moderate amount of air pollution increase, and created 158 Federal Class I areas, allows for minimal deterioration of current air quality, that met the outlined requirements. Class I areas in Wisconsin are Rainbow Lake Wilderness in Washburn Ranger District and the Forest Potawatomi Community Reservation near Crandon. The Bad River Band of Lake Superior Chippewa and the Fond du Lac Band of Lake Superior Chippewa are pursuing redesignation of their reservations to Class I status. For more information about Class I areas, go to: https://dnr.wisconsin.gov/topic/AirPermits/ClassI.html. At this time, all state lands are Class II. There are no Class III areas.

In the past ten years there has been no reported impacts to Class 1 airsheds in or near the proposed project area, the Rainbow Lakes Wilderness Area in the Washburn Ranger District or the Forest Potawatomi Community Reservation located about 5 miles away from the Lakewood-Laona Ranger District.

The proposed action would generate short term (non-point) vehicle emissions from equipment and associated activities. The burning of infected wood piles would also generate short term smoke emissions. The proposed activities would be implemented over a roughly 20-year period. This means the effects would be spread out over a longer term. Implementation of similar activities has occurred over the past 15 years and air quality monitoring parameters have still met the National Ambient Air Quality Standards. With this in mind, we can determine the exhaust, smoke, and dust from the action alternatives would disperse quickly and have no effect on any measured air quality parameter, as defined in the State of Wisconsin Air Quality Trends report.

During the burn plan writing phase, the proposed treatment areas would be studied to determine if there are any sensitive receptors that could be impacted by pile burning. Sensitive receptors include high population areas, hospitals, schools, and anywhere where increased smoke could cause or elevate health concerns. Areas of high travel, such as roads, highways, airports will also be taken into consideration so as to not impede safe travel routes. In the event that an air quality watch or advisory is declared by the DNR, signatories to the Proposed Wisconsin Regional Haze State Implementation Plan Revision for the Second Implementation Period agree to cancel all open burning related to prescribed fire use for the applicable county or counties affected by the burn while the advisory remains in effect. If areas are identified, the burn plans will be adjusted to burn only under specific environmental

parameters, such as dispersion index and wind directions. If an area is deemed too hazardous to be burned, it potentially can be treated mechanically.

The project area is currently subject to air pollutants and greenhouse gas emissions from mobile sources, such as vehicles, logging equipment, ATV's and similar recreational vehicles, and small engines, including lawn mowers and chainsaws. Due to dissipation by the wind, pollutants from these sources do not attain high enough concentrations to warrant measurement or to result in degradation to sensitive resources.

Supporting Project Documentation

Table 12: Applicable project file documentation to support CAA compliance.

Documentation Type	File Name(s)
Oak Wilt Disease Management Air Quality Effects Analysis	AirQualitySpecialistAnalysis.docx

NATIONAL HISTORIC PRESERVATION ACT (NHPA) – SECTION 106 REVIEW

The pertinent specialist has reviewed the project and made the following determination regarding Section 106 compliance:

OTHER - SEE EXPLANATION OF OTHER DETERMINATION IN COMMENTS SECTION.

COMMENTS

Treatment of oak wilt includes both non-ground disturbing and ground disturbing activities. For non-ground disturbing activities, such as girdling, hand cutting, or fungicide injections of infected trees, that do not have the potential to effect historic properties if present [36 CFR § 800.3(a)(1)], the forest has no further obligation under Section 106 and the treatment may proceed.

Ground disturbing activities, such as regeneration harvesting, use of vibratory plows or other trenching tools to cut root systems will require review of the proposed project area per Section 106 of the National Historic Preservation Act as well as any applicable Programmatic Agreements between the Forest Service, Wisconsin State Historic Preservation Office and the Advisory Council on Historic Preservation, and a determination of effect to historic properties will be made for the project area. This determination will require consultation with the State Historic Preservation office and Tribes as outlined in Section 106 or the Programmatic Agreement.

If it is determined that the project will have an adverse effect to historic properties, then resolution of that adverse effect will follow 36 CFR § 800.6 and 800.7.

SUPPORTING PROJECT DOCUMENTATION

Table 13: Applicable project file documentation to support NHPA compliance.

Documentation Type	File Name (if applicable/needed)
Programmatic Agreement	2014_WSHPO_CNNF_PA_signed

SOIL RESOURCES

The pertinent specialist has reviewed the project and made the following determination:

Effects from runoff into wetlands resulting from soil erosion and displacement are expected to not be significant. Risk to erosion and displacement can be identified using site-specific ratings identified for each soil type in the Landtype Phase database. Refer to Clean Water Section for additional information. In rare cases, supplemental soil stabilization and seeding would be required to mitigate erosion and runoff.

Effects from rutting and compaction are not expected to be significant. Site-specific risk ratings identified for each soil type would be assessed and treatments would not typically involve large-scale timber extraction leading to heavily confined skid trail use. In the rare case where the stand regeneration (clearcut) option is used, detrimental soil disturbance would be expected to fall within standard harvest thresholds.

The soil types occurring with oak stands are of upland nature and typically sandy to coarse loamy textured. These soil types are low risk to effects from equipment operability. In very steep slopes over 35% erosion potential becomes high risk due to equipment wheel slippage, however, on steep slopes, excavators and vibratory plow equipment used for the root rupture and root graft barrier methods would typically not be feasible. If for some reason, under the highly unlikely circumstance, heavy equipment was determined to be needed on steep slopes, site-specific mitigation measures outlined in the best management practices and other Forest Plan guidelines would mitigate for displacement and erosion.

Effects to soil productivity would not be significant. The root rupture treatment option would be expected to cause heavy but localized amounts of soil disturbance in the form of displacement and subsoil surfacing. In these areas, productivity decreases for some plant and tree species would be expected, however, other plants and tree species, such as birch and oak, would likely benefit by disturbance through enhanced seedling regeneration. Similarly, but to a lesser degree, periodic large wind events, such as blowdowns, and tornadoes which uplift roots and expose subsoil are considered natural soil forming factors and contribute to species as well as structural forest diversity. With the limited size and pattern of oak wilt outbreaks expected, and the expected nature of soil disturbance being localized, this would not result in significant effects at a landscape level.

SUPPORTING PROJECT DOCUMENTATION

Table 14. Applicable project file documentation to support agency soils compliance.

Documentation Type	File Name (if applicable/needed)
Preliminary Effects Worksheets – Soils	OakWilt Soils Pre_Effects_Worksheet_v3.docx

EXECUTIVE ORDER 12898 - ENVIRONMENTAL JUSTICE

The pertinent specialist has reviewed the project and made the following determination: According to the U.S. Environmental Protection Agency, there are no known community-identified environmental justice issues in the 15-county Northern Wisconsin Economic Impact Area (Ashland, Bayfield, Florence, Forest, Langlade, Lincoln, Marinette, Oconto, Oneida, Price, Sawyer, Taylor, and Vilas counties in

Wisconsin; and Dickinson and Iron Counties in Michigan) used to be consistent with the analysis in the 2004 Forest Plan FEIS (U.S. Environmental Protection Agency 2021). The project will adhere to Forest Plan direction on tribal relations and treaty obligations (Forest Plan, page 1-8). Tribal consultation efforts are described on page 4. It is not expected that this project will have any disproportionate effects to minorities or populations living below poverty

The U.S. Environmental Protection Agency defines environmental justice as "the fair treatment and meaningful involvement of all people regardless of race, color, national origin, or income with respect to the development, implementation, and enforcement of environmental laws, regulations, and policies (U.S. Environmental Protection Agency 2017). Fair treatment means that no group of people, including racial, ethnic or socioeconomic groups should bear disproportionately high and adverse human health or environmental effects resulting from Federal agency programs, policies, and activities (Executive Order 12898 February 11, 1994).

Data collected by the U.S. Census Bureau for the 15 counties referenced above were reviewed as part of this analysis. Results for economic characteristics and demographics for each county are in the project record. The affected environment is based on the percentage of the population whose income is below the poverty level for each county and the percentage of minority population for each county.

According to the results, 17.8% of the population in Ashland County, 16.3% of the population in Forest County, 14.9% of the population in Price County, 13.7% of the population in Iron County, Michigan, 13.0% of the population in Langlade County, 12.7% of the population in Sawyer County, 11.5% of the population in Marinette County, 11.2% of the population in Vilas County, and 10.9% of the population in Florence County live below the poverty line, which is higher than the national average of 10.5%. The remaining six counties range from 9.1 to 10.3% of the population below the poverty line. The U.S. Census Bureau uses a set of money income thresholds that vary by family size and composition to determine who is in poverty. If a family's total income is less than the family's threshold, then that family and every individual in it is considered in poverty (U.S. Census Bureau 2021).

According to the U.S. Census Bureau results, 17.7% of Sawyer County, 15.4% of Forest County, 11.7% of Ashland County, 10.9% of Vilas County, and 10.5% of Bayfield County populations are of American Indian and Alaska Native ethnicity. A half of a percent to 2% of the populations in the remaining 10 counties in the analysis area are of Native American Indian and Alaska Native ethnicity (U.S. Census Bureau 2021). The Bad River Reservation is the largest Chippewa reservation in the state (124,655 acres) and is in northern Ashland County. There are currently 6,945 tribal members. The reservation of the Lac Courte Oreilles Band of Lake Superior Chippewa Indians of Wisconsin (76,465 acres) is located mostly in Sawyer County. Total tribal enrollment is 7,272 members. The Potawatomi Reservation, which is located primarily in Forest County, totals 12,000 acres. The Forest County Potawatomi Community includes 1,400 tribal members. The Lac du Flambeau Indian Reservation (86,600 acres) is in southwestern Vilas County. There are currently 3,415 Lac du Flambeau tribal members. (Wisconsin Department of Public Instruction 2021)

Other ethnicities, including multiracial, Hispanic, Black, Asian, Hawaiian and Other make up less than 8% of the populations in the abovementioned counties (U.S. Census Bureau 2021).

APPENDIX B – RESPONSE TO COMMENTS

Comment #	Name	Title	Organization
1	Timothy Dettman	President	Clean Kill Pest Control
2	Lee Ann Bennett	Individual	
3	Norman K. Bickford	President	Wisconsin County Forests Association

Comment #	Comment	Response
1-1	We can help if needed, using Arbor Jet Tree injections.	Thank you for your offer and comment.
2-1	It sounds like a labor-intensive plan to remove/treat trees with oak wilt. There seems to be a large number of acres of oak trees on the forest.	Managing oak wilt infections can be labor intensive. Having multiple control options as summarized in table 1, page 14, will allow us to make the best treatment decision for each site. Acres of oak forest by district are displayed in table 2 on page 9.
2-2	Would fire spread the fungus, is that why it wasn't suggested in the oak wilt brochure as a way to dispose of infected trees or wood?	Fire is one tool that may be used to dispose of potentially spore-producing trees (page 14). Piling and burning trees killed by oak wilt renders the wood unsuitable for spore mat formation the following spring (figure 1, page 2). This reduces the risk of overland spread of the disease. Root systems of trees would be insulated from the effects of fire. Below ground movement of the oak wilt fungus would be managed by installing a root graft barrier using one of the methods described on pages 9-11.
2-3	Once the sick trees are dealth with, will you replant oaks in these treated areas? Or will you wait several years to replant and then plant different species?	Natural regeneration of trees species already existing in the stand would be expected in a regeneration harvest. Tree planting could be done in stands that failed to meet post-harvest stocking guidelines for regeneration. Tree species selected for planting would be reviewed by the interdisciplinary team on a case by case basis. Risk of oak

Comment #	Comment	Response
		wilt to oak regeneration would be minimal after thorough removal of infected trees and stump treatments (Cummings Carlson/. and Martin 2001) (see page 9). Sites treated with the root rupture method on the Lakewood-Laona Ranger District have revegetated with a high diversity of species, including oak (page 10).
2-4	Also, are you going to use pheromone traps to attract and kill the beetles that vector the disease? This could be a way to keep infected beetles from flying to new uninfected trees.	The beetles that serve as primary vectors of oak wilt are generalist sap-feeding beetles that have several other roles in the environment and are not specific to oaks and oak wilt. There are no known pheromones that can be used to trap these insects, but they are attracted to decaying fruit, plant saps, and fungi, so "baits" can be used to attract and capture the adult beetles. This is used for monitoring presence and activity, not for control the beetles. See the recent publication by Jagemann et al. for more information. Jagemann, S., J. Juzwik, P. Tobin, and K. Raffa. 2018. Seasonal and Regional Distributions, Degree-Day Models, and Phoresy Rates of the Major Sap Beetle (Coleoptera: Nitidulidae) Vectors of the Oak Wilt Fungus, Bretziella fagacearum, in Wisconsin. Environmental Entomology 47(5):1152–1164 https://academic.oup.com/ee/article/47/5/1152/5037764
2-5	Is there any technology that was developed for treating other species of trees with beetle infestations that could be useful for dealing with oak wilt?	Generally the type of beetle infestations that kill trees directly are bark beetles and wood boring beetles; the sap-feeding beetles, or nitidulids, are an entirely different group of insects, with a different ecology. So we cannot use the same technologies (insecticides, sanitation, etc.) to control presence of the sap-feeding beetles. (But we can use sanitation [destruction of infected wood] to control the presence of the oak wilt fungal mats).
2-6	Finally, will the chainsaws and other equipment used to cut down infected trees and extract their trunks have to be cleaned or sprayed with something to keep them from spreading fungal spores?	The oak wilt fungus is quite specific in how it is naturally spread overland: through targeted activity of sap-feeding beetles that move it from fungal mats to fresh open wounds on trees. The fungus itself does not compete well with other fungi and does not survive heat well. Thus it is highly unlikely to be spread to a healthy tree in the hot, oily sawdust on chainsaw blades. However, it is still best practice to clean your

Comment #	Comment	Response
		chainsaw between cutting diseased and healthy oaks, and sanitize the blades of pruning shears and other tools between cuts on other trees.
3-1	The Wisconsin County Forests Association (WCFA) appreciates the opportunity to comment on the proposal outlined in your August 13 correspondence to treat oak wilt infection sites across the Chequamegon-Nicolet National Forest. WCFA represents the forestry interests of 30 counties with lands enrolled under Wisconsin's County Forest Law (state statutes §28.10 and §28.11). Collectively, our member counties manage over 2.4 million acres of forest lands with many of these County Forests in close proximity to the Chequamegon-Nicolet and several also dealing with oak wilt issues.	Thank you for your comment.
3-2	WCFA supports the proposed action that lists a variety of treatments that may be selected from to control or slow the spread of this disease. The documentation provided clearly demonstrates that prompt action is needed when new infection sites are found.	Thank you for your comment.
3-3	As noted in the documentation, and one our member counties have been dealing with, is the challenge to detect new infection sites (often single infected trees) across the large forested landscapes of Wisconsin. New tools are needed to actually keep managers ahead of the curve on this and other forest disease issues. Several of our member counties have also begun utilizing drones for	Thank you for your offer and comment.

Comment #	Comment	Response
	detection purposes and would be eager to discuss the pros and cons of these techniques with Forest staff.	
3-4	Certainly, oak wilt and other forest disease and pest issues are of major concern to all who own or manage forests in this region. WCFA members look forward to continue to work in cooperation with Forest staff to provide healthy, diverse and productive forests across all land ownerships in Wisconsin. Please feel free to contact us for any questions or assistance you may have.	Thank you for your offer and comment.

APPENDIX C – DESIGN CRITERIA AND BEST MANAGEMENT PRACTICES

- All Forest Plan standards and guidelines will be met. Wildlife guidelines may be adjusted, as appropriate, during site-specific review.
- Timing of treatments will follow the guidance from the document "Timeline of various components of oak wilt management, relevant to northern Wisconsin." (Linda Haugen, April 17, 2020 version or subsequent revisions). https://usfs.app.box.com/file/789083870197
- Wisconsin's Best Management Practices for Water Quality will be implemented.
- Best management practices and design features for riparian management zones will be followed for all activities in all Federal and State Wild, Scenic and Recreation Rivers.
- Hand tools will be used in wilderness areas.
- No even-aged management is allowed within 200 feet of Federal, Scenic and Recreation segments.
- No even-aged management practices can be visible from State Wild River segments - minimum 400-foot buffer.
- The proposed oak wilt treatment would be designed to meet the Chequamegon-Nicolet Forest Plan standards and guidelines for snag retention requirements (p. 2-14). A minimum of 10 of the largest snags per acre would be retained, where available. There would be adequate abundance of snags around the treatment sites since most of the stands within the project area had at least 150 trees per acre > 6 inches at dbh.
- Activities proposed by the project are not prohibited by the final NLEB 4(d) Rule as these activities will not result in removing a known occupied maternity roost tree or removing any trees within 150 feet of a known occupied maternity roost tree from June 1 through July 31. In addition, trees will not be removed at any time of year within 0.25 mile of a hibernaculum.
- Within areas determined to be occupied by American marten, Forest Plan guidelines would apply (Forest Plan, 2004):
    - Guideline: Incorporate Management Area 2B Reserve Tree Guidelines (Forest Plan, Chapter 3) relative to tree numbers and diameters to even and uneven-age managed stands, where existing tree diameters allow.
- Forest Plan standards and guidelines protecting bald eagle nests would be implemented.
- Forest Plan guideline for protecting known toothwort (Cardamine diphylla), the host plant for West Virginia White butterfly catepillars, locations, and at least 80% canopy crown cover over and extending at least 100 feet from the perimeter of known toothwort sites will be maintained. Isolation of toothwort populations from larger blocks of interior forest will be avoided.
- To lessen the potential impact to wood turtles, the following mitigation/design features would be implemented;

  - Restrict treatment activities within 300 m of overwinter stream habitat from April 1 through October 1.

- There are Forest Plan guidelines which protect active and historic nest sites. Guidelines may be altered based on site-specific conditions. Any alterations of Forest Plan guidelines will be in consultation with a biologist, to meet the intent of the established guidelines.

- The Forest Plan does contain the following guidelines which pertain to RFSS plants in general and/or pertain to non-native invasive plants which can affect rare plant populations:

  - Vegetation management within 100 to 500 feet of RFSS plant sites will be limited to practices that maintain or enhance habitat and micro-habitat conditions (USDA, 2004, p. 2-20).

  - Avoid direct mechanical disturbance of known sites (USDA, 2004, p. 2-24).

  - Maintain stand level ecosystem components, patterns, and pit and mound microtopography (USDA, 2004, p. 2-3).

- Avoid the placement of log landings in areas infested with non-native species (USDA, 2004, p. 2-25).

- Minimize the need for prescribed burn area fire lines and soil disturbance by using existing barriers where possible (USDA, 2004, p. 2-25).

- Use permissible mechanical, biological, and chemical controls to reduce the spread of non-native invasive species (USDA, 2004, p. 2-25).

- Utilize frozen soil requirements where warranted (USDA, 2004, p. 2-3). Although primarily a soil consideration, frozen ground restrictions also greatly reduce the likelihood of moving soil that may contain NNIP seeds or plant propagules from site to site.

- New oak wilt site discoveries will be surveyed for rare plants in a timely fashion prior to management decisions and implementation.

- Newly discovered RFSS plant sites located in treatment areas will be well buffered and avoided during project implementation (see Section VI. - Management Matrix).

- Clean off-road equipment used for timber harvest or road construction or decommissioning prior to use on National Forest lands unless evidence is provided the off-road equipment last operated in a weed free area. Clean equipment used in sites already documented as weed infested, prior to leaving the contaminated sites unless movement is into another work area already infested with the same weed species. Such equipment should have all mud and plant parts removed. To best comply with this, begin operations in un-infested areas before operating in weed-infested areas. The sale administrator, harvest inspector, contracting official, or other designated official would conduct monitoring of equipment cleaning throughout the duration of ground disturbing activity. The timber sale contracting officer would approve equipment cleaning sites on National Forest land after consulting with the district botanist (Timber Sale Contract Provision, 2400-6T, BT6.25, PR 5B_001).

- Heavy equipment operation (vehicles, harvest equipment, machinery, etc.) will avoid travel through or placement in known weed-infested areas. These areas will be flagged or signed by Timber Sale Administrator or Harvest Inspector (Timber Sale Contract Provision, 2400-6T, BT6.25, PR 5B_001).

- Use mechanical, biological, and chemical controls to reduce the spread of non-native species.

- In the event that previously unreported cultural resources are encountered during ground disturbing activities, all work must immediately cease within 30 meters (100 feet) and Forest archaeological staff shall be notified. Once Forest archaeological staff have documented the discovery and evaluated its eligibility for the NRHP in consultation with the Forest Archaeologist, SHPO, and Tribes, as appropriate, work may resume in this area only with approval of the Forest Archaeologist.

- If human remains are encountered during ground-disturbing activities, all work must immediately cease within 30 meters (100 feet) of the discovery. Forest archaeological staff, SHPO, and appropriate Tribes shall be notified of the discovery within 24 hours. All discoveries will be treated in accordance with NAGPRA (Public Law 101-601; 25 U.S.C. 3001-3013), and work shall not resume in this area without authorization from the Forest Archaeologist.

APPENDIX D – MINIMUM INTER-TREE DISTANCES

Minimum inter-tree distances, based on combined tree diameters and soil type, to be 95% confident that root graft transmission of oak wilt has not occurred (Bruhn and Heyd 1992).

Combined DBH	Inter-tree distance (feet)			Combined DBH	Inter-tree distance (feet)		
	Sandy	Loamy Sand	Sandy loam/ Loam		Sandy	Loamy Sand	Sandy loam/ Loam
2	3.9	3.1	2.2	**26**	50.4	40.2	29.1
4	7.8	6.2	4.5	**28**	54.3	43.2	31.3
6	11.6	9.3	6.7	**30**	58.2	46.3	33.5
8	15.5	12.4	8.9	**32**	62.1	49.4	35.8
10	19.4	15.4	11.2	**34**	66.0	52.5	38.0
12	23.3	18.5	13.4	**36**	69.8	55.6	40.2
14	27.2	21.6	15.6	**38**	73.7	58.7	42.5
16	31.0	24.7	17.9	**40**	77.6	61.8	44.7
18	34.9	27.8	20.1	**42**	81.5	64.9	46.9
20	38.8	30.9	22.3	**44**	85.4	68.0	49.2
22	42.7	34.0	24.6	**46**	89.3	71.1	51.4
24	46.6	37.1	26.8	**48**	93.1	74.1	53.6